

Attorney's Docket No. 2359 (GP-01-13)

**July 23, 2001**

Non-Provisional Patent Application

of:

Bruce T. Boone

Gregory D. Budz,

Michael R. Kilgore,

Jonathan R. Aumann

and

James B. Christensen

for

Metering Napkin Dispenser

## METERING NAPKIN DISPENSER

### 5 Claim for Priority

This non-provisional application claims the benefit of the filing date of U.S. Provisional Patent Application Serial No. 60/274,678, filed March 9, 2001.

### Technical Field

10       The present invention relates generally to napkin dispensers, and more particularly to a metering napkin dispenser provided with a napkin storage magazine for receiving a stack of folded napkins and a metering member adapted to penetrate the stack to segregate a predetermined number of napkins for dispensing.

### 15 Background

Dispensers for sheet products are known in the art; such articles may be relatively simple depending on the product and the result desired. There is shown in United States Patent No. 5,810,200 to *Trokhan*, for example, a tissue package provided with a dispensing opening through which tissues are dispensed. There is  
20       disposed in the opening an engaging tab which separates one tissue from another when a tissue is pulled thereover by a user.

Other devices for dispensing sheet products may be more complex, for instance, when it is desired to distribute one article at a time. Illustrative in this  
25       regard are United States Patent No. 4,953,746 to *Andriash* for a one-at-a-time coupon dispenser and United States Patent No. 6,135,315 to *Gremillion III et al.* for a newspaper vending method and apparatus. So also, metering paper towel dispensers are typically those where a continuous roll or fan-fold sheet is advanced and cut to a desired length; see United States Patent No. 2,850,345 to *Marcuse et al.*

Devices for dispensing stacks of folded napkins or paper towels are generally gravity feed devices, or spring biased devices where the stack is urged to a dispensing aperture by a follower, where they are pulled from the opening by a user. Various designs have been employed to prevent binding, tearing, bunching or the distribution of large clumps of napkins which can be wasteful since they will be unnecessarily discarded.

In the United States Patent No. 4,155,484 to *Pastore* there is shown a napkin dispenser adapted to receive two stacks of napkins. The napkins are urged by respective spring members to a dispensing aperture where they may be grasped and removed by a user.

United States Patent No. 4,938,382 to *Frazier et al.* discloses a cabinet for dispensing paper sheets from a stack provided with a restricting means for preventing a technician from overfilling the device. Such overfilling can create unwanted pressure about the dispensing aperture and prevent proper operation.

United States Patent No. 5,100,020 to *Petterson et al.* discloses a dispenser apparatus for serially dispensing products such as paper napkins from a stack. The dispenser apparatus includes a housing which has a radius of curvature corresponding to the radius of curvature of a stack of folded napkins. The folded napkins are of non-uniform thickness by virtue of the fact that they are unequally folded (Fig. 3) so that a stack has an inherent tendency to curve when stacked.

United States Patent No. 5,219,092 to *Morand* discloses a dispenser for dispensing interleaved folded towels. The dispenser has front and back walls joined by sidewalls and a bottom wall defining a dispensing slot. The dispenser is provided with a plurality of supports projecting inwardly from the interior of the front and back walls for partially supporting substacks of paper towels in the dispenser. The

supports reduce the weight carried on the bottom of each sub-stack. Further provided is a stepped bottom profile to facilitate dispensing.

#### Summary of Invention

Napkin dispensers are desirably relatively simple to operate and are preferably  
5 of robust and inexpensive construction. A particularly desirable feature of the invention is the dispensing of a predetermined number of napkins in response to the action of a metering member. There is provided generally in accordance with the present invention a product metering napkin dispenser including: (a) a napkin magazine for receiving a stack of folded napkins; (b) shelf means for releasably  
10 retaining the stack of napkins about a terminal portion of the napkin magazine; (c) a metering member; and (d) means for providing relative motion between the metering member and the shelf means. The dispenser is configured such that the metering member penetrates the stack of napkins a pre-determined distance from the shelf means in a metering operation thereby segregating a pre-determined number of  
15 napkins from the remainder of the stack for dispensing. In some embodiments both the metering member and the shelf means are moveable with respect to the napkin storage magazine, whereas in other embodiments either the metering member or the shelf means may be stationary.

20 A particularly advantageous construction of the inventive dispenser includes a housing for receiving a stack of folded napkins, a movable shutter for retaining the stack in a closed position and a metering member configured so as to be capable of metering a predetermined number of napkins to be dispensed while retaining the stack in the housing during a dispensing operation. The shutter and the metering member  
25 are configured to cooperate in a dispensing operation such that the metering member penetrates the stack of napkins to segregate a predetermined number of napkins from the remainder of the stack and retain the remainder of the stack in the housing while the shutter moves to an open position and the segregated napkins are dispensed.

In one preferred embodiment a product metering, napkin dispenser includes a pivoted metering member and a trap-door shelf. There is thus provided in accordance with one embodiment of the present invention: (a) a housing defining a napkin magazine for receiving a stack of folded napkins; (b) a moveable shutter hinged to the housing for retaining the stack of folded napkins in the housing in a closed position; (c) a metering member pivotally mounted on the housing and coupled to the moveable shutter, the metering member being configured so as to be capable of retaining the stack of folded napkins in the housing, wherein the moveable shutter and the metering member are positioned, configured and dimensioned to cooperate to dispense a pre-determined number of napkins in a dispensing operation whereupon pivotal motion of the metering member; (i) the metering member penetrates the stack of folded napkins a pre-determined distance from the moveable shutter in the closed position thereby segregating the pre-determined number of napkins from the remainder of napkins in the stack and thereby retaining the remainder of the napkins in the stack; and (ii) the hinged moveable shutter swings to an open position thereby releasing the pre-determined number of napkins. One way of coordinating the motion of the metering member and the hinged shutter is by way of a cam member coupled to the moveable shutter having a cam surface which engages the metering member. Most preferably, the napkin dispenser is a gravity-feed napkin dispenser.

20

In another preferred embodiment a metering napkin dispenser in accordance with the present invention is provided with a pair of co-rotating shutters mounted to rotate concurrently in order to dispense a pre-determined number of napkins. There is thus provided: (a) a housing defining a napkin magazine for receiving a stack of folded napkins; (b) a moveable retaining shutter mounted to rotate in a dispensing plane for retaining the stack of napkins in a closed position; (c) a metering shutter mounted to rotate concurrently with the moveable support shutter at a pre-determined distance from the support shutter, wherein the moveable shutter and the metering member are positioned configured dimensioned to cooperate to dispense a pre-

25

determined number of napkins in a dispensing operation whereupon rotation of the retaining shutter and metering shutter: (i) the metering shutter revolves to penetrate the stack of folded napkins at a pre-determined distance from the moveable shutter thereby segregating the pre-determined number of napkins from the remainder of  
5 napkins in the stack and thereby retaining the remainder of napkins in the stack; and (ii) the moveable shutter revolves to an open position thereby releasing the pre-determined number of napkins. One convenient way to construct the dispenser in accordance with this embodiment is to mount the moveable support shutter and the metering shutter about a single rotatable shaft.

10

In yet another embodiment there is provided a product metering, gravity feed napkin dispenser including: (a) a housing defining a napkin magazine for receiving a stack of folded napkins; (b) a support releasably supporting the stack of folded napkins about a dispensing plane at a terminal portion of the napkin magazine; (c) a  
15 metering carriage provided with a napkin metering member projecting from the metering carriage; (d) a guide configured for directing the metering carriage during operation of the napkin dispenser, the guide having an inward portion and an outward portion, the inward portion being disposed proximately to the stack of folded napkins for guiding the metering carriage downwardly during a dispensing stroke over which  
20 napkins are dispensed and the outward portion being disposed outwardly with respect to the inward portion for guiding the metering carriage upwardly following the dispensing stroke; (e) biasing means to urge the metering carriage upwardly to a rest position; and (f) drive means coupled to the metering carriage for advancing the metering carriage along the guide in the dispensing cycle, the drive means being  
25 generally adapted to overpower the force exerted on the metering carriage by the biasing means. The guide and metering carriage are configured and arranged such that during the dispensing stroke the metering member penetrates the stack of folded napkins at a pre-determined distance above the dispensing plane and exerts a downward force on a pre-determined number of folded napkins which are thereby

released from the support as the metering carriage advances downwardly along the inward portion of the guide. A particularly preferred embodiment includes a gripping member adapted to cooperate with the metering member to grip the pre-determined number of folded napkins between the metering member and the gripping member during the dispensing stroke.

In still yet another aspect of the present invention there is provided a method of dispensing a pre-determined number of folded napkins from a napkin stack including the steps of: (a) disposing a stack of folded napkins in a napkin magazine atop a support releasably supporting the stack; (b) penetrating the stack with a metering member such that the metering member is between the pre-determined of napkins and the remainder of napkins in the stack; and (c) providing relative motion between the support and the metering member operative to dispense the pre-determined number of napkins. These and other aspects and features of the present invention are discussed in detail below.

#### Brief Description of Drawings

The invention is described with reference to the appended drawings wherein:

**Figure 1** is a front view in perspective of a first napkin dispenser constructed in accordance with the present invention;

**Figure 2** is a partial view in perspective generally from the right side and partial cutaway showing various parts of the napkin dispenser of **Figure 1**;

**Figure 3** is a partial exploded view showing various parts of the napkin dispenser of **Figures 1** and **2**;

**Figure 4** is an enlarged view in elevation of the offset axle which supports the metering lever handle of the napkin dispenser of **Figure 1**;

5       **Figures 5A and 5B** are perspective and end schematic views of a three-panel folded napkin with a continuous surface along one edge which may be used in the napkin dispensers of the present invention;

10       **Figures 5C and 5D** are perspective and end schematic views of a four-panel folded napkin with a continuous surface along an edge which may be used in the napkin dispenser of the present invention;

15       **Figures 6 - 8** are partial views in section and elevation along the center line of the napkin dispenser illustrated in **Figures 1-4** generally from the left side schematically illustrating the operation of the inventive napkin dispenser;

**Figure 9** is a view in perspective of another napkin dispenser constructed in accordance with the present invention;

20       **Figure 10** is a partial view in perspective, partially cut away of the napkin dispenser of **Figure 9** illustrating various parts as seen generally from the left side thereof;

25       **Figure 11** is a partial view in perspective of a napkin dispenser of **Figure 9**, showing various parts as seen generally from the right side thereof;

**Figure 12** is a plan view showing the support shutter of the napkin dispenser of **Figure 9**;



**Figure 13** is a plan view showing the metering shutter of the napkin dispenser of **Figure 9**;

**Figure 14** is an enlarged partial view along line 14 of the metering shutter of **Figure 13** illustrating the blunted knife edge which engages the stack of napkins;

**Figure 15** is an exploded partial view showing various parts in perspective of the napkin dispenser of **Figure 9**;

**Figures 16 and 17** are views in elevation and section along the center line of the napkin dispenser of **Figure 9** as seen from the right side, schematically illustrating operation of the dispenser;

**Figure 18** is a front view in elevation of another napkin dispenser of the present invention wherein the door is open to expose the storage magazine;

**Figure 19** is a partial view in perspective showing the dispensing aperture and various parts of the napkin dispenser of **Figure 18**;

**Figure 20** is a side view in elevation of the napkin dispenser of **Figures 18 and 19** as seen from the right side;

**Figures 21-24** are sequential side views from the right side, in elevation and section, of the napkin dispenser of **Figures 18-20** along the centerline of the dispenser illustrating operating of the dispenser;

**Figure 25** is a partial view in perspective showing various mountings and mechanical features of the inventive napkin dispenser of **Figures 18** and following;

**Figure 26** is an exploded perspective view of the parts shown in **Figure 25**;

**Figure 27** is an exploded view of selected parts shown in **Figures 25** and **26**;  
and

5

**Figure 28** is a schematic illustration of still yet another mode of practicing the present invention.

10 In the various embodiments illustrated, like numerals indicate the identical part thereof.

#### Detailed Description

15 The invention is described in detail below with reference to the various figures. Such description is for purposes of exemplification and illustration only and is in no way limitative of the present invention. Modifications to particular embodiments within the spirit and scope of the invention exemplified will be readily apparent to those of skill in the art.

20 The present invention includes gravity-feed product metering napkin dispensers having: (a) a napkin magazine or storage compartment for receiving a stack of folded napkins; (b) shelf means for releasably supporting the stack of folded napkins and thereby retaining the napkins in the housing; (c) a metering member; and (d) means for providing relative motion between the metering member and the shelf means wherein the shelf means, metering member and the means for providing  
25 relative motion between the metering member and the shelf means are configured and arranged such that the metering member penetrates the stack of napkins a pre-determined distance from the shelf means in a metering operation thereby segregating a pre-determined number of napkins from the remainder of the stack for dispensing. Numerous embodiments of the invention may be constructed. Typically, the shelf

means are located about the lower portion of the napkin magazine. In some embodiments, the metering member is mounted such that it advances to penetrate the stack in the metering operation and retracts so as to allow the napkins to advance toward the shelf means in between metering operations. In some preferred  
5 embodiments, the shelf means are moveable with respect to the stack of folded napkins in the napkin magazine. For example, in one embodiment the shelf means are hinged about the lower portion of the napkin magazine so as to swing downwardly to release napkins while a metering plate supports the stack. In another embodiment a support plate and a metering plate are rotatably mounted about a shaft  
10 and are configured to release napkins upon rotation of the shaft.

The metering member may or may not be moveable with respect to the napkin stack. In a preferred embodiment the metering member is pivotably mounted and has an arcuate plate portion adapted to penetrate the stack in the metering operation. In  
15 another embodiment the metering member comprises a generally planar member rotatably mounted about a shaft adapted to penetrate the stack upon rotation of the shaft. In still yet another embodiment, the metering member is mounted on a metering carriage adapted for reciprocating motion with respect to the stack of folded napkins. Alternatively, the metering member could be stationary and the support  
20 shelf movable with respect thereto.

In preferred embodiments the napkin dispenser is a gravity feed napkin dispenser and is inclined so as to accommodate the stack of napkins at an angle of from about 8° to about 15° with respect to a vertical. From about 10° to about 12°  
25 with respect to the vertical is typical.

The stack of folded napkins typically includes a plurality of folded napkins with a continuous surface about at least 1 edge thereof arranged in a stack such that the continuous surfaces are along one face of the stack and the metering member

penetrates the stack at the face presenting the continuous surfaces of the folded napkins. The folded napkins may be provided with a plurality of panels of substantially equal size; for example, 3 or 4 panel napkins. Optionally, there may be provided a plurality of support ridges projecting into the interior of the napkin storage magazine or chamber configured to frictionally engage the stack of folded napkins and distribute its weight to the walls of the napkin dispenser.

Referring to **Figures 1-4** there is shown a first napkin dispenser **10** including a housing **12** provided with a lower portion **14** of the housing. The housing defines a napkin storage magazine **16** with a back wall **18**, support ridges **19**, a right sidewall **20**, and a left sidewall **22**. Further provided is a top wall **24**, and a door **26**. There is also provided a left front retainer **28** and a right front retainer **30**. Retainer **28** is spaced apart from retainer **30** so as to facilitate the loading of napkins into the dispenser as will be appreciated from the discussion which follows.

There may optionally be provided a pair of buckles **32,34** as well as a plurality of closure tabs **36-42** as shown in **Figure 1**. Door **26** is optionally provided with a lower portion which covers a gap **46** between the retainers along the front of the dispenser during operation. A product receiving chute **48** is provided about the lower portion **14** of housing **12** for receiving napkins dispensed from the dispenser.

A metering lever **50** is mounted about an axle **66** for pivotal motion. Axle **66** is perhaps better seen in **Figure 4** which is an enlarged elevational view thereof. In general axle **66** has a bowed or offset configuration with a central offset portion **74** and two curved portions **76, 78** about its terminal portions. Further provided is a handle portion **80** for turning the axle. It should be appreciated from the geometry of the offset axle **66** that the position of metering lever **50** maybe adjusted by rotating handle **80**.

A metering shutter **52** (**Figure 2**) is attached to lever handle **50** and may be integrally formed therewith if so desired. Metering shutter **52** is actually curved planar in shape as is best appreciated perhaps from **Figures 2** and **3** and is generally perpendicular to metering lever **50**.

5

There is further provided a support shutter **54** hinged to the housing by way of a right axle portion **68** and a left axle portion **70**. Support shutter **54** includes a cam **56** attached to its underside which may or may not be integrally formed with shutter **54**. Cam **56** rides in a slot **58** and controls the position of support shutter **54**. Cam **56** is optionally provided with means for limiting the rotation of lever **50** and may include a hole **60** holding a pin **62** as shown in **Figure 2**.

10

In order to return lever **56** to a rest position, there is also optionally provided a spring **64** attached to lever **50** and to an outer wall **72** provided at the back of the housing rearwardly of back wall **18**. The housing also includes holes **82,84** for receiving axle **66** whereas lever **50** has holes **86** and **88** which retain the metering member about the axle. The housing further includes holes **90,92** to receive the axle portions **68,70** of support shutter **54**. Another pair of retaining tabs **94,96** are placed at the end of chute **48** for retaining napkins being dispensed. Here again, a gap **98** is provided in order to facilitate the withdrawing of napkins from the dispenser.

15

20

While the inventive dispenser may be used with a variety of sheet products, it is particularly adapted to dispense folded napkins with a plurality of panels as well as a continuous surface about one edge. Suitable napkins may be 3 or 4 panel napkins with panels of substantially equal size. A 6½ by 12 inch rectangular napkin will thus have 3 panels of 6½ by 4 inches whereas in a three panel configuration and 4 panels of 6½ by 3 inches in a four panel configuration.

25

There is shown in **Figures 5A and 5B** diagrams of three panel folded napkin. **Figure 5A** is a schematic perspective view showing a rectangular napkin **101** in partially folded form wherein the various panels **103, 105** and **107** are shown. Napkin **101** may be a single rectangular sheet of 6½ inches by 12 inches folded into 3 substantially equal panels as shown. There are thus two folds, **109** and **111**. There is present at edge **113** a continuous surface **115** the significance of which will be appreciated from the discussion which follows.

Napkin **101** thus presents a dispensing length **119** and a dispensing width **121**. The dispensing length of napkin **101** is identical to a four-fold napkin of like size; however, a four fold napkin has a narrower configuration about its dispensing width as can be appreciated from **Figures 5C and 5D**.

There is shown in **Figures 5C and 5D** diagrams of a suitable four-panel folded napkin. **Figure 5C** is a perspective view showing a napkin **100** in partially folded form wherein the various panels **102, 104, 106** and **108** are shown partially in phantom lines. Napkin **100** may also be for example a single sheet of about 6 ½ inches by about 12 inches as above folded into four roughly equal panels as shown in **Figures 5C and 5D**. The napkin is folded into four panels **102, 104, 106, 108** as shown with folds **110, 112** and **114** as shown in **Figures 5C and 5D**. As will be appreciated from the diagrams the napkin is continuous at fold **110** that is, a continuous surface **116** is formed by the napkin along this edge. In general folded napkin **100** presents a dispensing length **118** and a dispensing width **120**.

The significance of the napkin length and width is perhaps greater with respect to embodiments of the present invention which utilize a dispensing aperture rather than a trap door or dispensing shutter (see **Figure 18** and following), however, the support and metering shutters are generally configured so as to be large enough to support a stack of napkins to be dispensed. The napkins may be quite lightweight,

however, when folded in the four panel configuration of **Figures 5C and 5D**, the napkins may have, for example, an average thickness of about 25/1000 of an inch or so (25 mils) when folded. A basis weight of from about 10 pounds per 3000 square foot ream to about 25 pounds per 3000 square foot ream may be typical. A 16 inch  
5 stack may contain 600 to 650 napkins and weigh 6 pounds or more. In general, the napkin dispenser of the present invention is adapted to accommodate a stack of such size. In this respect it might be typical to have the enclosure or storage chamber roughly 1/8 of an inch larger or more in all directions than the stack of napkins sought to be dispensed. It is preferred to orient the napkins so that their continuous surfaces  
10 such as surfaces **115, 116** are all arranged on one face of the stack and have the metering member penetrate the stack on that face so that the dispenser operates optimally. In the various embodiments illustrated herein it is preferred to orient the folded napkins of **Figures 5A through 5D** in a stack so that all of the continuous surfaces, such as **115, 116** are disposed adjacent the back wall (**18** in **Figures 1-4** and  
15 **6-8**) of the napkin storage magazine and have the metering member approach through the back wall as discussed further herein. In this respect, back wall **18** defines a slot **122** between back wall portions **124, 126** that is substantially shorter than dispensing length **118** or **119** of napkins to be dispensed so that the napkins are not inadvertently drawn into the dispenser mechanism. To facilitate illustration, folded napkins such as  
20 napkins **100** or **101** are shown as a single line in the diagrams which follow.

Operation of the inventive napkin dispenser **10** is illustrated in **Figures 6-8**. A stack of napkins **128** is disposed in napkin dispenser **10** as shown in **Figure 6**. Stack **128** may consist of napkins of the type shown in **Figures 5A through 5D** and is  
25 supported on support shutter **54** which is hinged to housing **12** by way of its backward hinged portion **130**. Napkin storage magazine **16** is preferably inclined as shown in **Figures 6-8** at an angle **132** of from about 8° to about 15° with respect to a vertical indicated at **134**. Typically the vertical would be parallel to the wall upon which the napkin dispenser is mounted.

In the rest position shown in **Figure 6** support shutter **54** supports the napkin stack in a closed position and is locked in that position by way of cam **56** which rides in slot **58** of the metering lever **50**. Metering lever **50** is pivotally mounted about axle **66** as described above. The metering lever **50** is optionally urged towards the rest position shown in **Figure 6** by a spring **64** which may be attached to the metering shutter or the metering lever as shown in the diagram. As noted above the position of lever **50** and thus metering shutter **52** may be adjusted by way of bowed axle **66** simply by turning handle **80** to achieve the desired gap **136** between support shutter **54** and metering shutter **52**. As can be seen in **Figures 6-8** shutters **52** and **54** are generally planar although arcuate in shape. Gap **136** is of pre-determined dimension so that when the metering shutter penetrates the stack of napkins a pre-determined number of napkins is segregated from the remainder of the stack as will be appreciated from **Figures 7** and **8**. As lever **50** is pressed downwardly as shown in **Figure 7** the pivotally mounted lever rotates clockwise such that metering shutter **52** intrudes through slot **122** and also penetrates stack **128** as shown in **Figure 7**. Since gap **136** corresponds to the thickness of a pre-determined number of napkins these napkins indicated generally at **138** are segregated from the remainder of the stack. As metering shutter **52** advances it is also operative to support the remainder of stack **128**. It should be noted that the continuous surfaces such as surface **116** are facing wall **18** so that when the metering shutter penetrates it does not separate panels of a particular napkin. So also as the metering lever rotates clockwise as shown in **Figure 7** lever **50** advances along a cam surface **140** of cam **56** which is configured to urge support shutter **54** to a closed position during early stages of advancing the metering shutter.

When metering lever **50** advances to a sufficient degree, as shown in **Figure 8**, cam surface **140** is configured to allow support shutter **54** to open like a trap door and release segregated napkins **138** from the dispenser. Thus, the inventive napkin



dispenser segregates a pre-determined number of napkins by way of metering shutter 52 which is operative to support stack 128 and then dispenses segregated napkins 138 by way of opening the trap door or support shutter 54. The napkins then fall into chute 48 and are held in place by retainers 94,96 until grasped by a user of the dispenser.

Following dispensing of the napkins, handle 50 is released by a user and spring 64 urges the napkin dispenser back to the position indicated in **Figure 6**. The weight and geometry of the metering member also favors this position. It will be appreciated by one of skill in the art that various features are present to facilitate smooth operation of the device. For example, support shutter 54 is hinged below its center line 55 such that the trap door will fall away from the metering member 52 when the trap door opens, that is so the gap between the metering member and the support member at its hinged portion will not decrease and tend to bind a napkin in place. So also, slot 122 is substantially shorter than the dispensing length of the folded napkins so that the metering shutter 52 will not draw napkins through the slot as it travels backwardly and jam the device.

Typically the napkin magazine is inclined so as to accommodate the stack of napkins at an angle of from about 8° to about 15° with respect to a vertical as shown in the diagrams. From about 10° to about 12° with respect to the vertical is typical. There is also preferably provided a plurality of ridges 19 which operate to frictionally engage the stack of napkins and distribute its weight to the back wall of the dispenser. It is likewise possible to provide support ridges at other locations within napkin magazine 16 in order to appropriately distribute the weight of the napkin. The moveable shutter used to meter the napkins is in the embodiment shown in **Figures 6-8**, is an arcuate plate. In some embodiments it is also desirable to provide the metering plate with a blunted knife edge portion adapted to penetrate the stack of napkins to be dispensed as discussed in more detail below.

While the napkin dispenser may be provided with any suitable means for biasing the moveable shutter to the closed position, this may be done simply by employing suitable geometry and materials for the metering lever and metering shutter such that gravity will perform this function, or if so desired, one may supply biasing springs as shown in the Figures above. In general, a metering lever is affixed to a metering plate which is generally perpendicular to the metering handle. These pieces may be integrally formed as by way of injection molding and so forth, or may be fabricated in separate pieces. In general the inventive dispenser may be made from any suitable material such as metal or plastic with plastic being preferred for most parts.

Inasmuch as the inventive napkin dispenser may be used in a variety of applications, it is desirable to include means for adjusting the distance between the metering plate and the support plate such that the number of napkins dispensed in a dispensing operation may be varied. This is accomplished in the embodiment described in connection with **Figures 1-4 and 6-8** by way of a bowed or offset axle about which the metering lever is pivotally mounted. The support shutter is in general freely rotating and driven by the cam member. Due to its configuration, it will naturally tend to rotate downwardly unless locked into place by way of the cam member. Typically, the device is configured such that the cam member locks the support shutter in a closed position between dispensing operations. The cam member may likewise include means for limiting the rotation of the metering member in the direction opposite the dispensing directions. For example, this may be accomplished by way of a pin in hole **60** if so desired as noted above.

By way of summary of the foregoing, there is thus provided in accordance with a first embodiment of the present invention a very simple dispenser with only two major moving parts. The dispensing cycle is self clearing so that even if the

metering plate should hit a napkin edge – on, the dispenser will typically dispense the napkin in any event. In general, the concept utilizes a separation plate and trap door to dispense napkins. The napkins rest on a locked trap door while a blunted separator goes between the napkins from the back of the cabinet. As the separator nears the front of the cabinet and holds up the stack, the trap door opens allowing the bottom allotment of napkins to fall by gravity to the receiving chute. In this configuration the separation plate is the same piece as the activation handle, so that when the handle is released the trapdoor closes and the separator plate retracts to its initial back most position. There is a cam extending from the trap door shaped such that it protrudes to a slot in the activation or lever handle so that the otherwise freely rotating trap door is driven by the activation handle. The trap door is also locked in an upward position when the activation handle is not depressed. This keeps the weight of the stack from inadvertently causing the trap door to open. The hole in the back wall is big enough for the separator plate to rotate through, yet has two walls that extend to the floor. These keep napkins from being drawn back into the mechanism on the return stroke.

In **Figures 9-17** there is shown yet another embodiment of a napkin dispenser constructed in accordance with the present invention. Briefly, in this embodiment, a sideways sweeping motion is utilized to penetrate the stack. The working mechanism consists of two half disks, approximately 180° apart and axially spaced upon a rotatable shaft. The upper disk is fixed to the rotatable shaft and the bottom or support disk is able to freely slide along the shaft. The top disk has two pins extending downward that fit into holes in the lower disk so the lower disk is driven by the upper disk. The lower disk can be raised or lowered on the shaft relative to the upper disk by means of a linkage and adjustment lever. The shaft is centered between small bearings and is rotated by a gear which is driven by a rack on an activation push bar. A spring returns the shaft to the starting rotation. The push bar slides in a linear path.

The stack of napkins sits in the cabinet similar to the embodiment of **Figure 1** and following while the napkins rest on the lower disk which protrudes more than half way into the napkin magazine. Because the disk protrudes in so far, no other lips or shelves are needed to hold the napkins, which reduces dependence on napkin tolerance. The cabinet should be able to tolerate napkins that are as much as ½ inch out of spec. The push bar is pressed and the rack and pinion gear rotate the shaft causing the upper disk and attached lower disk to rotate concurrently as one unit. The upper (metering) disk has a blunted knife edge on a spiral shape. The spiral shape causes the metering disk to contact the napkins at the center and propagate the segregation action to the outside. The gradual insertion of the disk affords the napkin more time to be directed up or down. The space between the upper and lower disk can be set to correspond to the desired number of napkins. The upper disk is held in place while the lower disk can be raised or lowered. The disks are rotated so the napkins that are held by the lower disk fall out of the cabinet into the receiving chute while the upper disk rotates into place to hold up the stack. It is one seamless and smooth movement. When the push bar is released a spring returns the push bar and disk to the original position and the stack of napkins lowers to rest on the bottom disk again. Interestingly enough the motion of the disks work equally well if they turn 180° and return or if they proceed a full 360° in the forward direction. This facilitates fully automatic operation by simple addition of a motor and another gear. There could be hand sensing, push buttons, or cash register controls to control the dispenser. Particular features are better appreciated by considering **Figures 9-17** in more detail.

Referring to **Figures 9-17**, a napkin dispenser **160** includes a housing **162** defining a storage magazine **164** for receiving a stack of napkins. The storage magazine has a back wall **166** provided with a plurality of ridges **168** thereon for frictionally engaging a stack of napkins and transferring some of the weight of the napkins to the housing. There is further provided a door **170** with closure tabs **172**, **174**. These closure tabs cooperate with closure tabs **176** and **178** which may be

magnetic if so desired as well as buckles **188** and **190** to close the napkin magazine during use. The housing further includes a sidewall **180** and a sidewall **182** as well as a top **184**.

5           A working mechanism **186** generally includes a slideably mounted push bar **192** which includes a rack **194** positioned to engage a gear **196** mounted upon a rotatable shaft **198**. On the shaft there is provided a support shutter **200** as well as a metering shutter **202**.

10           Push bar **192** is provided with slots **204**, **206** through which retaining bolts **208** and **210** protrude in order to secure the push bar to housing **162**. There is further provided a mainspring **212** about shaft **198** which biases shaft **198** and thus the various shutters to a rest position as discussed further below.

15           The housing further includes a chute **214** as well as napkin retaining tabs **216**, **218**, **220** and **222**. There is further provided a wire round **224** having a generally bowed or offset profile mounted about its central portion **226** in a support member (not shown) for adjusting the height of support disk **200** on shaft **198**. The wire round is mounted in an eccentric slot **228** in a disk **230** attached to an adjustment lever **232**.

20           As the adjustment lever **232** is rotated the wire round, due to its offset shape will force collar **234** upwardly or downwardly upon the shaft and thus adjust the distance of support shutter **200** and metering shutter **202**. In this way, one may adjust the number of napkins that are dispensed upon pressing push bar **192**. That is to say, wire round **224** engages a slot **236** in collar **234** at its end portion and thereby can  
25           raise or lower disk **200**. It should further be appreciated from the various diagrams that there is defined in the housing a gap **238** between back wall **166** of storage magazine **164** and chute **214** of the dispenser through which the support shutter and the metering shutter rotate. It will further be seen that spring **212** is engaged on shaft **198** by a pin **240** and is secured to the housing floor by a bolt **242**.

Support shutter **200** is coupled to co-rotate with metering shutter **202** by way of pins **244,246** through holes **248** and **250** respectively which are also received in corresponding recesses in metering shutter **202**. Support shutter **200** includes a slot **252** as well as a downwardly directed trailing portion **254**. The support shutter is generally semi-circular disk-shaped and is mounted about shaft **198** at its central portion **256**. Metering shutter **202** is also generally semi-circular disk-shaped and is likewise mounted about shaft **198** about its central portion **258**. The metering shutter includes a leading edge **259** which is generally configured as a blunted knife edge shown schematically in **Figure 14** in order to penetrate a stack of napkins. The metering shutter generally includes about its leading edge **259** a spiral shape (increasing radius) so that the disk will gradually penetrate the stack as noted above. In general as can be seen from the diagrams the metering shutter and the support shutter are offset laterally by  $180^\circ$  and offset axially by a distance corresponding to a pre-determined number of napkins to be dispensed as will be further appreciated by reference to **Figures 16** and **17**.

Before turning to that discussion, however, it should be noted that a blunted knife edge is generally desirable when using a planar member for penetrating a stack of napkins to be dispensed in accordance with the present invention. **Figure 14** is an enlarged partial view in elevation of metering shutter **202** along line **14-14** of **Figure 13**. Leading edge **260** of metering shutter **202** has a flat portion **262** for penetrating a stack of napkins adjacent a pair of inclined portions **264** and **266** which extend from the blunted edge to the upper surface **268** and the lower surface **270** of metering shutter **202** respectively. With this shape, the shutter tends not to snag or cut the napkins.

There is shown in **Figures 16** and **17** a schematic diagram of the napkin dispenser of this embodiment dispensing a napkin stack **272** comprising a plurality of folded napkins as are shown in **Figures 5A through 5D** above. The napkins are

disposed in magazine 164 in an inclined manner as shown. Here again the napkin stack makes an angle 274 with a vertical 276 of from about 8° to about 15°. Typically the vertical 276 would simply be a wall upon which the napkin dispenser is mounted. The napkin stack 272 is frictionally engaged by ridges 168 on back wall 166 of the magazine in order to transfer some of the weight of the napkin to the housing. It will be appreciated that the angle of inclination of the stack also concentrates the gravitational force along the wall making it easier for the metering shutter to penetrate the stack of napkins.

**Figure 16** depicts the inventive napkin dispenser in a closed position wherein metering member 202 is disposed behind the back wall 166 of the napkin magazine and the support shutter 200 supports stack 272. The napkin dispenser is biased to this position by way of spring 212 which is coupled to the shaft 198 and the floor of the housing. When the push bar 192 is operated, that is pushed to the right by a user, the napkin dispenser working mechanism rotates by action of the rack and gear upon shaft 198. The metering shutter 202 penetrates the stack thus segregating a plurality of napkins 280 from the remainder of the stack and operates to support the stack while support shutter 200 rotates away from the stack (**Figure 17**) and in between the back wall and an outer wall 282.

It should be noted that here again the napkins are arranged so that their continuous surfaces such as surface 116 are adjacent wall 166 and are first to be penetrated with edge 260 of metering shutter 202. It is further noted that support shutter 200 is provided with a slot 252 opposite the leading edge 260 of metering shutter 202 to facilitate penetration of the stack of the metering member. That is to say, slot 252 provides an unsupported edge portion of the napkin stack which is less resistant to penetration than it would otherwise be.

When the support member rotates back to the rest position wherein it is in its closed position, the napkins will advance by gravity to the support shutter and the process may be repeated for another operation. The number of napkins which are dispensed depends upon the axial spacing between metering shutter **202** and the support shutter **200**. Typically one simply lowers the support shutter **200** to increase the distance from the upper, metering shutter **202**. It should also be noted that inasmuch as the napkin dispenser **160** operates by way of rotation it is advantageous to have a downwardly disposed trailing edge **254** to allow the napkins to smoothly fall away from support plate **200** as it rotates from its rest or closed position through gap **238** in the housing to its rearward open position.

There is shown in **Figures 18** through **27** yet another napkin dispenser **310** including a housing generally indicated at **312** which defines a storage chamber or napkin magazine **314**. There is also provided a door **316** mounted on a pair of hinges **326,328**. Door **316** is also provided with closure tabs **322,324** which cooperate with buckles **318,320** to secure the door in a closed position. Any suitable closure means may be used to secure door **316** to the remainder of the housing.

Door **316** may be provided with sights **330,332** in the form of elongated slots so that a user is able to monitor the level of the stack of paper napkins inside of the dispenser. There is provided at the lower extremity of napkin dispenser **310** a catch basket **334** which includes retaining members **336,338** as well as a catch plate **340**.

It can be seen **Figures 18** through **20** in particular that the napkin dispenser also defines a slot **342** to allow for the downward travel of a metering carriage **344**, the significance of which will become apparent from the discussion which follows. A dispensing aperture **360** is generally C-shaped in accordance with the embodiment of the invention, as is seen in **Figure 19**. The term C-shaped merely refers to the fact



that the dispensing aperture has a discontinuous perimeter, typically a discontinuous generally rectangular perimeter as is shown in Figures 19 and 28.

There is also provided retaining walls 346,348 to help secure the napkins after  
5 they are dispensed from the stack.

Napkin dispenser 310 is further provided with a top 350 as well as sidewalls 352 and 354 adjacent backwall 356. Together, top 350, sidewall 352, sidewall 354, backwall 356 and door 316 define a chamber for receiving a stack of folded napkins.  
10 At the lower portion of the chamber there is provided a supporting surface 358 about dispensing aperture 360. Surface 358 and aperture 360 are generally configured in a "C" shape as noted above and there is optionally provided a pair of rollers 362,364 (Figure 19) to help facilitate the dispensing of napkins. In a typical embodiment the aperture has a length 366 and a width 368 as indicated in Figure 19. Length 366 is  
15 typically shorter than the corresponding dispensing length (length 118, Figure 5A) of a folded napkin stacked in dispenser 310 such that the napkin will not pass through aperture 360 until urged to do so by the metering member of the napkin dispenser 310. The dispensing aperture generally has a length of anywhere from about 10% to about 30% shorter than the dispensing length of the folded napkins to be dispensed  
20 therethrough and typically from about 15% to about 25% shorter than the dispensing length of the napkins. Generally speaking, support surface 358 is typically planar and defines a dispensing plane 370 about aperture 360. There is also provided a support member 372 for receiving the napkins which is advantageously provided with wedge members 374,376 which are configured to urge the napkin stack towards back wall  
25 356.

Dispenser 310 may be further provided with one or more additional sights, such as sights 378 in the form of elongated slots in order to monitor napkin level; or alternatively and perhaps more desirably door 316 may be made from a transparent or

translucent material making such slots unnecessary. There is further provided within chamber 314; specifically on back wall 356 a plurality of ridges 380 as well as a pair of curved support members 382,384.

5           In general, it is preferred that a napkin dispenser of the present invention utilizes an inclined stack of napkins. That is to say the storage chamber generally arranges the napkin stack having an angle of inclination 386 of from generally about 8° to about 15°, typically about 10 to 12° and in a particularly preferred embodiment about 11°. The angle of inclination serves several functions. For one, the angle will  
10   facilitate distribution of the weight of the napkin stack on to back wall 356 so that the force about the dispensing aperture is not unduly great. For another, napkins are dispensed in accordance with the present invention by way of a metering member on metering carriage 344 which penetrates the stack of napkins. It is thus advantageous to incline and urge the napkins towards back wall 356 so that they are more easily  
15   grasped and drawn through dispensing aperture 360 as will become apparent from the discussion which follows. Inclining the magazine also makes the napkin dispenser easier to load with napkins. Likewise, it is preferred to use a folded napkin that presents a continuous surface that is free from edges, towards the back of the dispenser.

20

          In this respect, folded napkins as shown in **Figures 5A** through **5D** are also employed in connection with the dispenser shown in **Figure 18** and following. It is preferred to orient the napkins so that their continuous surfaces are all arranged on one face of the stack and have the metering member penetrate the stack on that face  
25   so that the dispenser operates optimally. In the various embodiments illustrated herein it is preferred to orient the folded napkins of **Figures 5A** through **5D** in a stack so that all of the continuous surfaces, such as surfaces 115, 116 are disposed adjacent the back wall of the napkin storage magazine and have the metering member approach through the back wall.

As noted above, the dispensing plane 370 is defined about supporting surface 358 which in turn is the upper portion of support platform 410. Inasmuch as the predetermined number of napkins, for example one, two, four, six or eight napkins at a time, are separated from a stack of napkins by the metering carriage 344, it is desirable to adjust the level of surface 358 with respect to the metering carriage. In this respect there are provided mounting screws 412,414 provided in slots 416,418 to adjust the metering length and thus the number of predetermined number of napkins to be dispensed, the one simply adjusts the height of platform 410 via screws 412 and 414 as can be best seen in Figure 19.

Operation of the inventive napkin dispenser is perhaps best appreciated by considering Figures 21 through 27. These figures illustrate sequentially operation of napkin dispenser 310 as the dispensing levers are depressed and metering carriage 344 travels downwardly in a metering stroke and is returned to a rest position by the main biasing spring. In general Figure 21 is a diagram in elevation and section of the invented dispenser wherein the metering carriage is disposed upwardly in a rest position whereas Figure 22 shows the metering carriage segregating two napkins to be dispensed and Figure 23 shows the metering device displacing two napkins through the dispensing plane. Figure 24 shows the metering carriage releasing a napkin into the catch basket 334 and Figures 25 through 27 show the various mountings and mechanical parts associated with carriage 344. Figure 25 is a perspective view showing the mechanism of the inventive napkin dispenser, whereas Figures 26 and 27 are exploded views thereof. The actual operation as shown in Figures 21 through 24 is perhaps better appreciated by first considering the mechanism shown in Figure 25 and following. There is shown metering lever members 345,347 which are mounted on a shaft 492 and connected via mounting pins, for example, pins 420,422 and mounting bar 424 to the metering carriage 444

via a recess 428 in sled 432 ( **Figure 26**). Carriage 344 includes member 434 and the various parts shown.

It should be noted that pin 422 goes through a slot 426 in mounting wall 429  
5 which is internal to the napkin dispenser. The mechanism of **Figures 25-27** is  
conveniently mounted on a back plate 427 which creates a sub-assembly including  
the supporting walls and the various reciprocating components. The sub-assembly  
may be secured to the housing by a plurality of screws such as screw 433. Sled 432 is  
also biased upwardly by a main biasing spring 430 which urges the metering carriage  
10 to an upper rest position as is shown in **Figure 21**. Attached to sled 432 is a metering  
member carrier 434. Metering member carrier 434 is attached to sled 432 via a pin  
436 which is received in a recess 438. In between the metering member carrier and  
sled 432 is a leaf spring 440 to urge member 434 forwardly during a dispensing  
operation as will be discussed in more detail below. A napkin metering member 442  
15 is carried on member 434 as shown in the various figures particularly in **Figures 26**  
and **27**. It should be noted that member 442 is fixedly mounted upon member carrier  
434 whereas a lower jaw 444 is pivotally mounted on carrier 434. There is also  
provided in connection with jaw 444 a pair of springs 452 and 454 to bias the opening  
and closing of the pincers formed by member 442 and jaw 444.

20

There is additionally provided a pair of rollers 456 and 458. Rollers 456 and  
458 which engage the retaining bars 460,462 along the inner surfaces which forces  
the jaw into the grasping motion seen in **Figures 21** through **24** as the metering  
carriage advances in a dispensing stroke.

25

More particularly the metering member carrier 434 is disposed in a pair of  
opposed tracks 446,447 in walls 429,431 one track of which is shown as 446 in  
**Figure 24** and both of which are shown in **Figure 25**. The metering member carrier  
is guided in tracks 446,447 by way of pins 464 and 466.

Operation of napkin holder **310** will be further appreciated by considering the details of yoke assembly **468** which carries jaw **444** as well as spring **454**, rollers **456**, **458** and is shown in exploded view in **Figure 27** together with metering member carrier **434**, spring **452** and a shaft **470** used to pivotally secure yoke assembly **468** to metering member **434**, wherein the various angular relationships between parts are biased by springs **452,454** as further discussed below.

**Figure 21** through **24** are views in elevation and section along the centerline of napkin dispenser **310** showing operation of dispenser **310** incorporating the various parts shown in **Figures 25** through **27** during a dispensing stroke and in rest position (**Figure 21**). It is noted that the dispenser is basically symmetrical about the centerline such that only one side need be shown (which is also the case with **Figures 25** and **26**, for example, track **447** is substantially identical to track **446** and mounting wall **431** is identical to mounting wall **429**. In **Figure 21**, metering carriage **344** is held upwardly by main biasing spring **430** in a rest position, and jaw **444** is biased downwardly by spring **452** as shown in **Figure 21**.

A stack of napkins **472** is loaded into the dispenser as shown, 1 line schematically indicating 1 folded napkin of the type shown in **Figures 5A** and **5B**. The weight of stack **472** is partially borne by back wall **356** because of angle of inclination **386** from the vertical **474** which is typically a wall upon which napkin dispenser **310** is mounted. Ridges **380** project inwardly into chamber **314** and frictionally engage stack **472**, also serving to support the weight of stack **472**. Likewise, curved support member **382,384** engage the stack and further support its weight.

When either metering lever member **345,347** or both are depressed downwardly by a user, carriage **344** moves downwardly and metering carrier member

**434** advances downwardly and toward the stack since pins **464,466** will travel downwardly in the inner portions **475,479** of tracks **446,447**. Note that metering member carrier **434** is urged forwardly by leaf spring **440** so that pins **464,466** are in track parts **475,479** during a downward dispensing stroke as is shown in **Figure 22**.

5

It can be seen in **Figure 22**, that as the metering member **442** advances downwardly and forwardly in a dispensing stroke, member **442** penetrates stack **472** and segregates a predetermined number of napkins (2 in the example shown) from the remainder of the stack. In the position shown in **Figure 22**, rollers **456,458** of yoke **468** engage retaining bars **460** and **462** which operates to compress spring **452** and move yoke **468** and jaw **444** upwardly with respect to metering member **442** as the carriage advances in a dispensing operation as shown in **Figure 22**. Jaw **444** is biased toward metering member **442** by spring **454** to grasp two napkins **476,478** to be dispensed. Member **442** and jaw **444** thus act as a pincer mechanism to grasp the napkins to be dispensed. If it is desired to dispense more or fewer napkins in a dispensing stroke, it is convenient to merely change the height of supporting surface **358** by loosening screws **412,414** and adjusting platform **410** by way of the position of the screws in slots **416,418**. In this manner, for example, the height above dispensing plane **370** that making member **442** penetrates the stack may be adjusted to correspond, for example, to 2, 4 or 6 folded napkins to be dispensed.

In the view of **Figure 23**, spring **452** is fully compressed by the action of the rollers on the retaining bars as metering member **442** travels further downwardly on member **434** and the metering member cooperates with jaw **444** to release napkins **476, 478** from support surface **358** through aperture **360** past dispensing plane **370**. Note in this position spring **454** biases closure about the napkins by members **442,444**.

In the view of **Figure 24**, the metering carriage continues to travel downwardly until rollers **456,458** travel past retaining bars **460** and **462**. Spring **452**

is thus released, urging jaw **444** downwardly as shown and thereby depositing napkins **476,478** in catch basket **334**. The inertia of yoke **468** as it springs downward operates to bias pins **464,466** into rear or outer track portions **480,482** of tracks **446** and **447**. The relative positions of **Figure 24** represent the finish of a dispensing stroke, where metering lever **345** is fully depressed. After the dispensing stroke is finished and the lever released, pins **464,466** travel up track portions **480,482** as main biasing spring **430** returns the metering carriage to the rest position of **Figure 21**.

The various parts of the inventive napkin dispenser may be made of any suitable material such as metal, plastic and so forth. Preferred for large planar pieces such as door **316** are relatively amorphous resins such as ABS (acrylonitrile-butadiene-styrene) resins, polycarbonate, poly(methylmethacrylate) and other impact modified styrenes, for example, high impact polystyrene (HIPS) which is typically prepared by blending styrene with K-resin (styrene-butadiene copolymer).

Mechanical parts such as members **442,444**, sled **432**, carrying member **434** and tracks **446,447** are advantageously made from engineering resins such as polyesters, polyacetals, nylons and so forth. Polyacetal, due to its ease of processing and natural lubricity, is a particularly preferred material. Formaldehyde homopolymer (e.g., Delrin® polyacetal) or copolymer (e.g. Celcon® polyacetal) are examples of suitable acetals.

The metering dispenser of the present invention exhibits remarkable consistency with respect to product dispensing. Even an early prototype exhibited the performance characteristics noted in Table 1 below.

Table 1 – Dispensing Performance Characteristics (early Prototype)

No. Pulls	Set Quantity	Within Target	Under Target	Over Target
1575	2	97%	0	3%
579	4	89%	1%	10%
1050	6	88%	9%	3%

- 5 A design as shown in **Figures 18-27** exhibited the performance characteristics listed in Table 2.

Table 2 – Dispensing Performance of Napkin Dispenser of **Figures 18-27**

No. Pulls	Set Quantity	Within Target	Under Target	Over Target
640	2	99	0	1

10

- Whereas, the invention has been described in detail in connection with the dispenser of **Figures 1-4** and **6-27**. Modifications to the dispenser will be readily apparent to those of skill in the art. For example, one could provide more than one metering member on metering carriage **344** to penetrate the stack as shown schematically in **Figure 28**. **Figure 28** is a schematic view wherein a support platform **484** is shown schematically in a view similar to **Figure 19** (i.e., similar to platform **410**) showing a dispensing aperture **486**, also generally C-shaped and two metering members **488,490** which operate equivalently to metering member **442** in dispenser **310** to urge folded napkins through the aperture. So also, one might configure a trap door/metering member combination in various ways, for example one could provide a support shutter on a lever adjacent a metering member on a lever which are both laterally and axially offset but move in the same direction to dispense napkins in accordance with the invention. That is to say, a sliding floor/sliding metering member which travel together across the lower part of a gravity feed napkin
- 15
- 20
- 25



dispenser could be constructed within the spirit and scope of the present invention.

So also, while it is typical to move the metering member in accordance with the present invention, it is likewise possible to provide for a stationary metering member and move the napkin magazine of the napkin dispenser relative thereto. Such

5 modifications are within the spirit and scope of the present invention which is set forth in the appended claims.